UNIVERSAL SLIDE ASSEMBLY FOR MOLDING AND CASTING SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATION(S)

Priority is claimed under U.S. Provisional Application No. 60/413,992, entitled Universal Slide Assembly for Molding and Casting Systems, and filed September 26, 2002, which is incorporated by reference.

BACKGROUND OF THE INVENTION

The present invention relates to injection molding and die casting processes. In particular, the present invention relates to injection molding and die casting slide systems.

Injection molding and die casting are manufacturing processes for producing a multitude of shapes and designs for plastic and metal products. Such processes generally incorporate two-component systems. The two components are the fixed-die half and the movable-die half. The fixed-die half is secured to the apparatus and contains a portion of a core or core where plastic or molten metal is injected into for curing or solidification.

In contrast, the movable-die half is capable of moving, and contains the other portion of the core where plastic or molten metal is injected into for curing or solidification. During a molding or casting cycle, the movable-die half moves towards and clamps to the fixed-die half so that the core is completely enclosed by the two halves. Once the core is sealed, the plastic or molten metal is injected to cure or solidify. After the cycle is completed, the movable-die half retracts away from the fixed-die half allowing removal of the molding or casting.

Such two-component systems may also incorporate slides mounted to the movable-die half to create key aspects of the moldings or castings that the movable-die half and the fixed-die half are incapable of producing. For example, a slide may contain a pin that extends into the core when the slide is positioned at the core. When the injected material cures or solidifies, the slide retracts, pulling the pin out of the molding or casting. This results in a hole within the molding or casting.

For more complex moldings and castings, multiple slides can be incorporated. The slides are positioned around a central core of the movable-die half. When a molding or casting cycle begins, the slides move forward and create a perimeter around the core. The movable-die half also moves towards and clamps to the fixed-die half so that the core is completely enclosed by the two halves and the slides. Once the core is sealed, the plastic or molten metal is injected to cure or solidify. After the cycle is completed, the movable-die half and the slides retract away from the core allowing removal of the molding or casting.

Currently in the industry, slides for an injection molding or die casting apparatus have to be individually tailored to the fixed-die half or movable-die half where the slide is mounted. The pertinent fixed-die half or movable-die half contains tracks that a particular slide must fit into. Such individualization of the slides is expensive and time consuming. This can be especially troublesome if a particular slide is defective or damaged during molding or casting cycles. Another identical slide must be obtained and installed before the process can continue. In addition, slides must be carefully installed into the tracks of the pertinent fixed-die halves or movable-die halves in order to ensure proper alignment when positioned at the core. This is also very time consuming and tedious, taking up time that otherwise could be used for operating the system. As such, there remains a need in the industry for a slide system that is easy to install and replace, while also being accurate and reliable in use with molding or casting cycles.

BRIEF SUMMARY OF THE INVENTION

The present invention is a universal slide assembly for a molding or casting systems used to introduce complex designs to moldings and castings. The present invention comprises a base, a slide inserted onto the base such that the slide is mobile relative to the base, and a cam lever that is insertable through the slide and the base. The base is directly insertable into a movable-die half or fixed-die

half for immediate use without requiring the slide to be individually designed or adapted to a particular movable-die half or fixed-die half.

In addition, the cam lever also is capable of moving the slide relative to the base through a cam action. When the cam lever is fully inserted into the slide and the base, the cam lever prevents the slide from moving relative to the base. However, when the cam lever is removed, it moves the slide relative to the base through a cam action. The cam lever is capable of moving the slide towards and away from a core without the use of hydraulic power. Therefore, the present invention is a universal design that is cost effective, easy to install, and easy to operate with injection molding or die casting processes.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 is an exploded perspective view of the present invention positioned above a die block.

Figures 2 is a perspective view of the present invention mounted to a die block.

Figure 3 is a perspective view of the present invention.

Figure 4 is a side view of the present invention.

Figure 5 is a front view of the present invention.

Figure 6 is an exploded view of the present invention.

Figure 7a is a perspective view of a base of the present invention.

Figure 7b is a top view of the base of the present invention.

Figure 8 is a perspective view of an alternative design for the base of the present invention.

Figure 9a is a perspective view of a slide of the present invention.

Figure 9b is a cross sectional view of the slide of the present invention along section 9b-9b of Figure 9a.

Figure 9c is a bottom view of the slide of the present invention.

Figure 10a is a perspective view of a cam lever of the present invention.

Figure 10b is a top view of the cam lever of the present invention.

Figure 10c is a right side view of the cam lever of the present invention.

Figure 10d is a front view of the cam lever of the present invention.

Figure 11 is a perspective view of an alternative embodiment of the present invention.

Figure 12 is a side view of the alternative embodiment of the present invention.

Figure 13 is a front view of the alternative embodiment of the present invention.

Figure 14 is an exploded view of the alternative embodiment of the present invention.

Figure 15a is a perspective view of a base of the alternative embodiment of the present invention.

Figure 15b is a top view of the base of the alternative embodiment of the present invention.

Figure 16 is a perspective view of the alternative design for the base of the alternative embodiment of the present invention.

Figure 17a is a perspective view of a cam lever of the alternative embodiment of the present invention.

Figure 17b is a top view of the cam lever of the alternative embodiment of the present invention.

Figure 17c is a right side view of the cam lever of the alternative embodiment of the present invention.

Figure 17d is a front view of the cam lever of the alternative embodiment of the present invention.

Figure 18a is a perspective view of an alternative design for the cam lever of the alternative embodiment of the present invention.

Figure 18b is a top view of an alternative design for the cam lever of the alternative embodiment of the present invention.

Figure 18c is a right side view of an alternative design for the cam lever of the alternative embodiment of the present invention.

Figure 18d is a front view of an alternative design for the cam lever of the alternative embodiment of the present invention.

Figure 19 is a perspective view of a second alternative embodiment of the present invention.

Figure 20 is a perspective view of a third alternative embodiment of the present invention.

DETAILED DESCRIPTION

Figures 1 and 2 are perspective views of universal slide assembly 22 and die block D, illustrating the ease of use and installation of universal slide assembly 22. Figure 1 is an exploded view that illustrates universal slide assembly 22 positioned above die block D. Figure 2 illustrates universal slide assembly 22 mounted to die block D for use with injection molding or die casting processes. Universal slide assembly 22 is a universal design that includes base 24, slide 26, cam lever 28, and pin 30. Die block D in Figures 1 and 2 is a movable-die half and includes mounting slot M and core C. Mounting slot M includes block slot B. Core C is a portion of the core or cavity in die block D where plastic or molten metal is injected for curing or solidification.

In addition to the components illustrated, Figures 1 and 2 also incorporate a fixed-die half (not shown), to which die block D is clamped, enclosing core C to create the complete molding or casting core. Alternatively, die block D may be a fixed-die half and a movable-die half would clamp to die block D, enclosing core C to create the complete molding or casting core. As such,

references to a movable-die half are only intended to be illustrative, and the slide assembly of the present invention is capable of being mounted to either a movable-die half and a fixed-die half.

Mounting location M is an opening in die block D to core C, and is the location where base 24 securely mounts, rendering base 24 immobile. Slide 26 inserts into base 24 so that slide 26 is mobile along base 24, for sliding towards, and retracting away from core C. Herein, general references to slide 26 moving forward relate to slide 26 sliding relative to base 24 in a direction towards a core of a molding or casting apparatus. Correspondingly, general references to slide 26 retracting relate to slide 26 sliding relative to base 24 in a direction away from the core of the molding or casting apparatus.

Once slide 26 is inserted into base 24, cam lever 28 is insertable from above through slide 26 and base 24, and into block slot B of die block D. When slide 26 is moved forward and is positioned at core C, cam lever 28 securely locks slide 26 with base 24, preventing slide 26 from retracting away from core C during a molding or casting cycle. Pin 30 is connected to a front portion of slide 26 and extends into core C when slide 26 is positioned at core C. As slide 26 retracts, pin 30 is pulled completely out of the solidified molding or casting, resulting in a hole within the molding or casting. Slide 26 may alternatively contain other conventional instruments and designs, as is known in the art.

The use of base 24 precludes the need to individually design or adapt slide 26 to be compatible with die block D. Slide 26 is completely entrained and mobile from within base 24, allowing universal slide assembly 22 to be installed into many different movable-die halves without requiring slide 26 to be individually designed or adapted to a particular mounting location 102. As such, universal slide assembly 22 may be installed, exchanged, and replaced with minimal time and expense.

Figures 3-5 are a perspective view, a side view, and a front view of

universal slide assembly 22 and include base 24, slide 26, cam lever 28, face plate 32, coupling 34, front lead bore 36, rear leads bore 38, leads 40, and leads 42. Base 24 is mountable to a movable-die half of an injection molding or die casting apparatus, such as die block D. Slide 26 inserts into base 24 allowing slide 26 to move forward and retract along base 24, precluding the need for slide 26 to be individually compatible with the movable-die half.

Face plate 32 is attached to the front end of slide 26 and is the portion of universal slide assembly 22 that is exposed to the molding core. Face plate 32 may contain mold patterns or instruments that affect the shaping of the molds. An example of this is pin 30, as illustrated in Figures 1 and 2. Pin 30 may be secured to face plate 32 through conventional means and allows universal slide assembly 22 to create a hole within the molding or casting. The use of different patterns and instruments accordingly increases the flexibility of universal slide assembly 22.

Coupling 34 is attached to the rear end of slide 26, the opposite end of face plate 32, providing a connection between slide 26 and a hydraulic actuator (not shown). When an injection molding or die casting product is being created, slide 26 must be positioned so that face plate 32 is set forward against the injection molding or die casting core, such as core C. As such, coupling 34 allows hydraulic power from the hydraulic actuator move slide 26 forward against the injection molding or die casting core. Coupling 34 also allows the hydraulic actuator to hold slide 26 in position while an injection molding or die casting product is being created by applying a constant pressure to slide 26. This prevents face plate 32 from pulling away and opening the molding core while an injection molding or die casting product is being created. When the injection molding or die casting product is completed, the hydraulic actuator releases the hydraulic pressure to allow slide 26 to retract along base 24. As such, coupling 34 provides a connection for a first system of moving slide 26 relative to base 24 for use with molding or casting

operations.

Front lead bore 36, rear leads bore 38, leads 40, and leads 42 provide a magnetic proximity switch monitoring circuit, defining the range of motion for slide 26. Front lead bore 36 and rear leads bore 38 and are holes located in the side wall of base 24. Leads 40 and 42 are each a pair of separate wires connected to front lead bore 36 and rear leads bore 38, respectively, for monitoring and limiting the position of slide 26 along base 24. When slide 26 moves forward to a certain position along base 24, leads 40 provide a signal to the source of hydraulic pressure to prevent further forward progression of slide 26 along base 24. Similarly, when slide 26 retracts back to a certain position along base 24, leads 42 provide a signal to the source of hydraulic pressure to prevent further retraction progression of slide 26 along base 24.

Leads 40 and 42 may also provide alternative signals for other components of the molding or casting system. For example, leads 40 may signal the injector to inject plastic or molten metal into the core. Leads 42 may signal the ejection pin to eject a finished molding or casting. Also, based upon the position of slide 26 relative to base 24, leads 40 and 42 may provide signals to instruct the movable-die half to open and close against the fixed-die half. These are several examples of the use of leads 40 and 42 in providing signals to other systems.

An additional advantage of incorporating leads 40 and 42 is that universal slide assembly 22 monitors the range of slide 26 via electrical means. This prevents problems associated with mechanical action, such as springs, which are affected by being coated and gummed up with excess plastics or metal.

Cam lever 28 is removably insertable into slide 26 and through base 24 from above, and includes head 44 and tail 46. When cam lever 28 is inserted into slide 26 and base 24, head 44 of cam lever 28 extends vertically from the top of slide 12, and tail 46 of cam lever 28 extends through slide 26 and base 24, and into block slot B of die block D. This arrangement mechanically locks slide 26 to base

24, preventing slide 26 from moving forward or retracting, and provides an additional locking system to the hydraulic locking from coupling 34.

Cam lever 28 also provides a second means for moving slide 26 relative to base 24 via cam action. When universal slide assembly 22 is installed into an injection molding or die casting apparatus, base 24 is mounted to a movable-die half of the apparatus (not shown), and head 44 of cam lever 28 is directly attached to a fixed-die half of the apparatus (not shown). As illustrated in Figure 4, head 44 is positioned at an angle to tail 46. When the movable-die half retracts from the fixed-die half, cam lever 28 is pulled out of base 24 and through slide 26. As cam lever 28 raises, the angle of tail 46 mechanically forces slide 26 to retract along base 24. This in turn pulls face plate 32 away from the molding core allowing the mold to be released.

Similarly, when the movable-die half closes with the fixed-die half for the next molding or casting cycle, cam lever 28 is reinserted through slide 26 and base 24. As cam lever 28 lowers, the angle of tail 46 correspondingly forces slide 26 to move forward along base 24, repositioning face plate 32 at the molding core. As such, cam lever 28 allows slide 26 to move forward or retract along base 24 without requiring hydraulic pressure from coupling 34. However, universal slide assembly 22 incorporates the capability of moving slide 26 relative to base 24 through either hydraulic pressure, cam action, or both. This illustrates the versatility of universal slide assembly 22.

Figure 6 is an exploded view of universal slide assembly 22 of Figures 3-5, further including guide pins 48, magnet 50, magnet holder 52, face plate bolts 54, front lead holder 56, rear leads holder 58, and tracks 60. Tracks 60 are grooves within base 24 upon which slide 26 is inserted and moves along. As such, slide 26 is completely entrained and mobile from within base 24.

Slide 26 includes pin bores 62, front bores 64, rear bores 66, slide bore 68, and slot 70. Guide pins 48 insert into slide 26 at pin bores 62 for aligning

face plate 32 with the front portion of slide 26. Face plate 32 is secured to slide 26 via face plate bolts 54, which are inserted from the rear of slide 26, through rear bores 66, and into front bores 64 and face plate 32. Cam lever 28 is removably insertable into slot 70 of slide 26 for mechanically locking slide 26 to base 24. This prevents face plate 32 from retracting during a molding or casting cycle.

Coupler 74, coupling bolt 72, rod end 76, and jam nut 78 are connected to form coupling 34. Coupling bolt 72 inserts through coupler 74 and into the rear end of slide 26. A first end of rod end 76 also inserts into coupler 74 for a secure connection. Correspondingly, jam nut 78 attaches to the other end of rod end 76. Coupling 34 provides a connection between slide 26 and a hydraulic actuator for allowing slide 26 to be hydraulically propelled and retracted along base 24.

Leads 40 and 42 are each a pair of separate wires for monitoring and limiting the position of slide 26 along base 24, as previously discussed. Leads 40 and 42 respectively end in switches 40a and 42a, which are magnetically actuated switches. Front lead holder 56 is inserted into base 24 at front lead bore 36 for connecting leads 40 and switch 40a to base 12. Similarly, rear leads holder 58 is inserted into base 24 at rear leads bore 38 for connecting leads 42 and switch 42a to base 12. Monitoring is performed through a magnetic proximity switch system, as is known in the art, where switches 40a and 42a are closed by the presence of magnet 50, without physically contacting magnet 50.

Magnet 50 is connected to slide 26 via holder magnet 27, which is retained in slide bore 68. When slide 26 moves forward to a position along base 24 where magnet 50 and switch 40a are in close proximity, switch 40a closes, signaling the source of hydraulic pressure to prevent further forward progression of slide 26 along base 24. Correspondingly, if slide 26 retracts to a position along base 24 where magnet 50 and switch 42a are in close proximity, switch 42a closes, signaling the source of hydraulic pressure to prevent further retraction progression

of slide 26 along base 24. Additionally, as previously discussed, leads 40 and leads 42 may provide signals for other components of the molding or casting system. As such, leads 40 and 42 allow for monitoring and limiting the position of slide 26 along base 24.

As illustrated in Figure 6, universal slide assembly 22 is adaptable for use with many different molding and casting processes. This reduces time and costs in installing, exchanging and replacing universal slide assembly 22.

Figure 7a is a perspective view of base 24 of universal slide assembly 22, as described in Figures 3-6. Figures 7a further includes tail slot 80 through which tail 46 of cam lever 28 extends when inserted into slide 26. This mechanically locks slide 26 to base 24 and prevents undesirable retractions of face plate 32 from the core of the molding or casting apparatus, which could otherwise ruin the molds and die casts.

Figure 7b is a top view of base 24 of universal slide assembly 22, as described in Figures 3-6, and 7a, which further includes mounting bores 82, illustrated by phantom lines, which are holes extending through the bottom surface of base 24. Base 24 is mountable to a movable-die half of an injection molding or die casting apparatus via bolts insertable through the movable-die half and into mounting bores 82 from underneath. While mounting bores 82 are illustrated in Figure 7b as four per side, the present invention is not intended to be limited to this number, and other numbers of mounting bores 82 may be used to secure base 24 to a movable-die half. With the use of mounting bores 82, base 24 is capable of being securely attached to a movable-die half with minimal time and effort.

Figure 8 is a perspective view of an alternative embodiment of base 24 of universal slide assembly 22, as described in Figures 3-6 and 7a. Base 24, as illustrated in Figure 8, further includes top-mounting bores 84, which provide an alternative mounting means for base 24, from that described in Figure 7b. Base 24, as illustrated in Figure 8, is mountable to a movable-die half of an injection

molding or die casting apparatus via bolts insertable from above. The bolts are inserted through top-mounting bores 84, which extend vertically through base 24, and into the movable-die half. This is in contrast to mounting bores 82, which require the bolts to be inserted from underneath. This further increases the versatility of universal slide assembly 22 by providing an alternative system for securely mounting base 24 to the movable-die half.

Figure 9a is a perspective view of slide 26 of universal slide assembly 22 of Figures 3-6, which further includes rails 86, which are extensions located at the lateral edges of slide 26, and are the portions of slide 26 that insert into tracks 60 of base 24. When rails 86 are inserted into tracks 60, slide 26 is capable of moving forward and retracting along base 24. Because base 24 is mountable to a movable-die half, slide 26 is not required to be individually designed or adapted to be compatible with the movable-die half. This allows universal slide assembly 22 the benefit of being installed into many different movable-die halves without requiring slide 26 to be individually designed or adapted to a particular movable-die half.

Figure 9b is a cross sectional view of slide 26 of universal slide assembly 22 along section 9b-9b of Figure 9a, which further includes coupling bore 88, the portion of slide 26 where coupling bolt 72 of coupling 34 inserts into slide 26. When attached to slide 26, coupling 34 provides a connection between slide 26 and a hydraulic actuator (not shown) for allowing slide 26 to hydraulically move forward and retract along base 24.

As illustrated in Figure 9b, slot 70 is channeled at an angle within slide 26. This angle corresponds to the angle of tail 46 of cam lever 28. When cam lever 28 is raised out through slot 70, tail 46 mechanically forces slide 26 to retract along base 24, pulling face plate 32 away from the core of the movable-die half. Correspondingly, when cam lever 28 is inserted into slot 70, tail 46 mechanically forces slide 26 to move forward along base 24, pushing face plate 32 towards the

core of the movable-die half. This allows cam lever 28 to move slide 26 relative to base 24 through cam action.

Figure 9b further illustrates the locations of front bores 64 and rear bores 66. Rear bores 66 extend between the rear portion of slide 26 and slot 70, and front bores 64 extend between slot 70 and the front portion of slide 26. As previously discussed, face plate 32 is secured to slide 26 via face plate bolts 54, which are inserted through rear bores 66 and into front bores 64. When fully inserted, face plate bolts 54 are retained solely within front bores 64, and extend out of the front of slide 26 for insertion into face plate 32. Rear bores 66 are access conduits for inserting face plate bolts 54 into front bores 64. The use of face plate bolts 54 allows slide 26 to connect with a multitude of different face plates 14, which may include instruments and designs, such as pin 30. This again illustrates the broad range of applications available with universal slide assembly 22.

Figure 9c is a bottom view of slide 26 of universal slide assembly 22, as described in Figures 3-6, 9a, and 9b. When slide 26 is moved forward, the portion of slot 70 at the bottom surface of slide 26, illustrated in Figure 9c, lines up with slot 48 of base 24. This allows tail 46 of cam lever 28 to extend through both slot 70 of slide 26 and slot 34 of base 12, preventing slide 26 from pulling away from the core.

Figures 10a-10d are respectively a perspective view, a top view, a right side view, and a front view illustration of cam lever 28 of universal slide assembly 22, and include head 44, tail 46, and fixed-die half bore 90. As illustrated, head 44 is positioned at an angle to tail 46. This allows cam lever 28 to function as a lever to move slide 26 relative to base 24 via cam action. When universal slide assembly 22 is installed into a movable-die half, head 44 is directly attached to a fixed-die half of the apparatus via fixed-die half bore 90. A bolt is inserted through the fixed-die half and into fixed-die half bore 90 of head 44, securely fastening cam lever 28 to the fixed-die half. When the movable-die half

retracts from the fixed-die half, cam lever 28 is pulled out of base 24 and through slide 26. As cam lever 28 raises, the angle of tail 46 mechanically forces slide 26 to retract along base 24, pulling face plate 32 away from the molding core allowing the mold to be released. Cam lever 28 allows slide 26 to move forward or retract along base 24 without requiring hydraulic pressure from coupling 34, providing a low-cost means of operating a slide assembly with an injection molding or die casting apparatus.

Figures 11-14 are a perspective view, a side view, and a front view, and an exploded view of universal slide assembly 122, encompassing an alternative design of universal slide assembly 22. As illustrated in Figures 11-14, universal slide assembly 122 includes slide 26, face plate 32, coupling 34, leads 40, switch 40a, leads 42, switch 42a, guide pins 48, magnet 50, magnet holder 52, face plate bolts 54, front lead holder 56, rear leads holder 58, and slide bore 68, which connect and interact as described above in Figures 3-6. Universal slide assembly 122 further includes base 124 and cam lever 128. Base 124 includes front coupler bore 136, rear coupler bore 138, and tracks 160, which are identical to front lead bore 36, rear leads bore 38, and tracks 60.

The first distinction between universal slide assembly 22 and universal slide assembly 122 regards the length of cam lever 128. As best illustrated in Figures 12 and 14, cam lever 128 includes head 144 and tail 146. Head 144 of cam lever 128 is identical to head 44 of cam lever 28. However, tail 146 of cam lever 128 is considerably shorter than tail 46 of cam lever 28, only extending down far enough to sit within slot 70 of slide 26. As such, when cam lever 128 is fully inserted into slide 26, head 144 extends vertically out of the top portion of slide 26, but cam lever 128 does not extend down beyond slide 26. Cam lever 128 does not provide a mechanical locking between slide 26 to base 124.

Nonetheless, cam lever 128 still provides a cam action means for moving slide 26 relative to base 124 for use with molding or casting operations.

When universal slide assembly 122 is installed into an injection molding or die casting apparatus, base 124 is mounted to a movable-die half of the apparatus (not shown), and head 144 is directly attached to a fixed-die half of the apparatus (not shown). When the movable-die half retracts from the fixed-die half, cam lever 128 is pulled out through slide 26. As cam lever 128 raises, the angle of tail 146 mechanically forces slide 26 to retract along base 124. This in turn pulls face plate 32 away from the molding core allowing the mold to be released.

Similarly, when the movable-die half closes with the fixed-die half for the next molding cycle, cam lever 128 is reinserted into slide 26. As cam lever 128 lowers, the angle of tail 146 correspondingly forces slide 26 to move forward along base 124, repositioning face plate 32 at the molding core. The cam action retains slide 26 in the forward position despite the fact that slide 26 and base 124 are not mechanically locked. Accordingly, the length of tail 146 of cam lever 128 defines the distance slide 26 is capable of moving along base 124 via cam action.

Cam lever 128 provides the capability of mounting universal slide assembly 122 to a movable-die half that would otherwise prevent the use of cam lever 28. As illustrated in Figure 4, tail 46 of cam lever 28 extends considerably below base 24. If base 24 is mounted on a movable-die half not allowing cam lever 28 to extend below base 24 (i.e., no block slot B), cam lever 28 is unusable. Cam lever 128, however, having a shorter tail 146, would be usable, and could move and retain slide 26 relative to base 24 via cam action.

Figures 15a, 15b, and 16 are a perspective view, a top view, and a perspective view of an alternative embodiment of base 124, as described in Figures 11-14, illustrating the second difference between universal slide assembly 122 and universal slide assembly 22. As illustrated in Figures 15b and 16, base 124 may include either mounting bores 182 or top-mounting bores 184, which are identical to mounting bores 82 and top-mounting bores 84.

Unlike base 24, base 124 does not incorporate a tail slot, such as tail

slot 80 of base 24. Because cam lever 128 does not extend into base 124 to lock slide 113 with base 124, a tail slot is not required, which reduces costs in manufacturing base 124. Alternatively, a base such as base 24 with tail slot 80 may be used in place of base 124 without any hindrance of performance in universal slide assembly 122. As such, base 124 may incorporate an assortment of features to accommodate a variety of molding and casting systems.

Figures 17a-17d are respectively a perspective view, a top view, a right side view, and a front view illustration of cam lever 128 of universal slide assembly 122. As illustrated, head 144 is identical to head 44 of cam lever 28, and is positioned at an angle to tail 146 for allowing cam lever 128 to provide a cam action to move slide 26 relative to base 124. When universal slide assembly 122 is installed into a movable-die half, head 144 is directly attached to a fixed-die half of the apparatus via fixed-die half bore 190. Fixed-die half bore 190 is identical to fixed-die half bore 90 of cam lever 28. A bolt is inserted through the fixed-die half and into fixed-die half bore 190 of head 144, securely fastening cam lever 128 to the fixed-die half.

When the movable-die half retracts from the fixed-die half, cam lever 128 is pulled out through slide 26. As cam lever 128 raises, the angle of tail 146 mechanically forces slide 26 to retract along base 124, pulling face plate 32 away from the molding core allowing the mold to be released. Cam lever 128 allows slide 26 to move forward or retract along base 124 without requiring hydraulic pressure from coupling 34. Accordingly, the length of tail 146 of cam lever 128 defines the distance slide 26 is capable of moving along base 124 via cam action. As such, the present invention may include a number of levers with varying lengths for moving and retaining slide 26 relative to base 124.

Figures 18a-18d are respectively a perspective view, a top view, a right side view, and a front view illustrations of cam lever 228 of universal slide assembly 122, where cam lever 228 includes head 244, tail 246, and fixed-die half

bores 290.

Figures 18a-18d illustrate another length of the tail of the locking component. As illustrated, head 244 is identical to head 44 of cam lever 28 and head 144 of cam lever 128, and is positioned at an angle to tail 246 for allowing cam lever 228 to provide a cam action to move slide 26 relative to base 124. When universal slide assembly 122 is installed into a movable-die half, head 244 is directly attached to a fixed-die half of the apparatus via fixed-die half bores 290. Fixed-die half bores 290 are identical to fixed-die half bore 90 of cam lever 28 and fixed-die half bores 190 of cam lever 128. A bolt is inserted through the fixed-die half and into fixed-die half bore 290 of head 244, securely fastening cam lever 228 to the fixed-die half.

Cam lever 228 incorporates the same benefit of cam lever 128 over cam lever 28, in allowing universal slide assembly 122 to be used with an apparatus, where cam lever 28 would not be capable of extending below base 24. As illustrated, tail 246 includes extension 246a, which extends from the bottom tip of tail 244 at the same angle from head 244 as tail 246. Extension 246a provides a greater range that slide 26 is capable of moving along base 124 via cam action, compared to cam lever 128. Additionally, extension 246a is capable of inserting further into slot 70 of slide 26 for providing a better fit when inserting cam lever 228 into slide 26. As such, Figures 18a-18d further illustrate the benefits of incorporating levers with different lengths for moving and retaining slide 26 relative to base 124. Figure 19 is a perspective view of universal slide assembly 322, a second alternative design of universal slide assembly 22 incorporating an axially longer base. Universal slide assembly 322 includes slide 26, face plate 32, coupling 34, leads 40, leads 42, and cam lever 128, which connect and interact as described in Figures 3-6 and 11-14. Universal slide assembly 322 further includes base 324, which includes front coupler bore 336 and rear coupler bore 338, which are identical to front lead bore 36 and rear leads bore 38.

The distinction between base 324 and both base 24 and base 124, is that base 324 is axially longer, providing a greater range for slide 26 to move forward and retract. Preferably, base 24 and base 124 provide a three-inch range of movement for slide 26. That is, front coupler bores 36, 136 and rear coupler bores 38, 138 are preferably separated by a distance of three inches. In comparison, base 312 preferably provides a four-inch range of movement (i.e., four inches between front coupler bore 336 and rear coupler bore 338). This greater range allows for insertion and retraction of longer components attached to face plate 32, which would not be possible with base 24 or base 124, and adds to the versatility of the present invention.Figure 20 is a perspective view of universal slide assembly 422, a third alternative design of universal slide assembly 22 incorporating an axially shorter base. Universal slide assembly 422 includes slide 26, face plate 32, leads 40, leads 42, and cam lever 128, which connect and interact as described in Figures 3-6 and 11-14. Universal slide assembly 422 further includes base 424, which includes front coupler bore 436 and rear coupler bore 438, which are identical to front lead bore 36 and rear leads bore 38.

As illustrated, base 422 is axially shorter than base 24, base 124, and base 324. Preferably, base 412 provides a one-half-inch range of movement (i.e., one-half inch between front coupler bore 436 and rear coupler bore 438). This limits the range of movement of slide 26 and is useful when small holes or designs are required and space is limited. Due to its smaller size, universal slide assembly 422 is capable of being used with a smaller injection molding or die casting apparatus, compared to universal slide assembly 22, universal slide assembly 122, and universal slide assembly 322.

Universal slide assembly 422 does not include coupling 34. Due to the short range of movement by slide 26, cam lever 128 provides enough cam action movement to meet the limited need. However, universal slide assembly 422 may also include coupling 34, connected to slide 26 as previously discussed,

without hindrance in performance. Additionally, as illustrated, cam action is preferably provided by cam lever 128. Due to the limited range of movement of slide 26, a lever with a long tail, such as cam lever 28 is not required, as it would provide too much cam action movement. However, universal slide assembly 422 may alternatively incorporate a lever with a differing length, such as cam lever 28 or cam lever 228, as individual processing may require. Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.